



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|-------------|----------------------|-------------------------------|------------------|
| 10/767,230 | 01/29/2004 | Sadayuki Ohnishi | NECB 20.919 (100806-00249) | 2594 |
| 26304 | 7590 | 07/29/2005 | EXAMINER | |
| KATTEN MUCHIN ROSENMAN LLP 575 MADISON AVENUE NEW YORK, NY 10022-2585 | | | HUYNH, ANDY | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2818 | |

DATE MAILED: 07/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|-----------------|----------------|--|
| Office Action Summary | Application No. | Applicant(s) | |
| | 10/767,230 | OHNISHI ET AL. | |
| | Examiner | Art Unit | |
| | Andy Huynh | 2818 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 July 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
- 4a) Of the above claim(s) 14-29 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-6 and 8-13 is/are rejected.
- 7) ☒ Claim(s) 2 and 7 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 September 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

In the Response to Restriction Requirement dated 07/08/2005, Applicant has elected Invention of Species I (Claims **6-13**) and Claims **1-5** is acknowledged. Accordingly, claims **14-29** are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 35 § 1.142(b) and MPEP § 821.03. Applicant has the right to file a divisional application covering the subject matter of the non-elected claims **14-29**. Claims **1-13** are currently pending in this application.

Priority

Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d) based on applications filed in JAPAN, 2003-021078 on 01/29/2003 and 2004-018080 on 01/27/2004.

Claim Rejections - 35 U.S.C. § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims **1 and 4** are rejected under 35 U.S.C. 102(b) as being anticipated by Jons et al. (USP 5,783,452 hereinafter referred to as "Jons").

Regarding claim 1, Jons discloses an insulating film/an adhering, formable, capping material comprises a carbon containing silicon oxide (SiOCH) film which has Si-CH₂ bond in the carbon containing silicon oxide film as set forth in column 4, lines 58-64.

Regarding claim 4, Jons discloses that the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process (col. 4, lines 65-67). However, the limitation "the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process" is taken to be a product by process limitation and consider non-limitation. In a product-by-process claim, it is the patentability of the claimed product and not of the recited process steps which must be established. Therefore, when the prior art discloses a product which reasonably appears to be identical with or only slightly different than the product claimed in a product-by process claim, a rejection based on sections 102 or 103 is fair. The Patent Office is not equipped to manufacture products by a myriad of processes put before it and then obtain prior art product and make physical comparisons therewith. In re Brown, 173 USPQ 685 (CCPA 1972). Also, a product by process claim directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ I S at 17 (footnote 3). See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al., 218 USPQ 289, 292 (Fed. Cir. 1983); and particularly In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product "gleaned" from the process steps, which must be determined in a "product by process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims **3 and 5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Jons et al. (USP 5,783,452 hereinafter referred to as "Jons") in view of Grill et al. (USP 6,764,774 hereinafter referred to as "Grill").

Jons discloses all the claimed limitations except for the relative dielectric constant of the insulating film is equal to or lower than 3.1, and wherein the carbon containing silicon oxide (SiOCH) film comprises methylsilsesquioxane. Grill teaches the low-k materials (as a SiCOH type dielectric of low dielectric constant ($k < 3.2$) (col. 3, lines 48) that have been considered for applications in ULSI devices include polymer containing Si, C, O and H, such as methylsilsesquioxane to reduce the capacitances of the interlayer dielectric in order to improve the switching performance of ULSI circuits (col. 1, lines 20-56). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form the low-k materials (as a SiCOH type dielectric of low dielectric constant ($k < 3.2$) (col. 3, lines 48) including polymer containing Si, C, O and H, such as methylsilsesquioxane, as taught by Grill in order to reduce the capacitances of the interlayer dielectric in order to improve the switching performance of circuits.

Claims **6 and 8-10** are rejected under 35 U.S.C. 103(a) as being unpatentable over Grill et al. (USP 6,764,774 hereinafter referred to as "Grill") in view of Jons et al. (USP 5,783,452 hereinafter referred to as "Jons").

Regarding claim **6**, Grill discloses in Figs. 1-6 and the corresponding texts as set forth in column 6, line 29-column 9, line 50, a semiconductor device 30 has an interlayer insulating film 34 formed on or over a semiconductor substrate 32 and a metal wiring conductor 36 which is formed by filling a wiring trench formed in the interlayer insulating film with Cu containing metal via a barrier metal 216 (Fig. 6), wherein the interlayer insulating film includes the insulating film comprising a carbon containing silicon oxide (SiOCH) film (col. 8, lines 53-55).

Grill fails to teach the insulating film comprises a carbon containing silicon oxide (SiOCH) film which has Si-CH₂ bond in the carbon containing silicon oxide film. Jons teaches that an insulating film/an adhering, formable, capping material comprises a carbon containing silicon oxide (SiOCH) film which has Si-CH₂ bond in the carbon containing silicon oxide film as set forth in column 4, lines 58-64. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to utilize the teaching of an insulating film/an adhering, formable, capping material comprises a carbon containing silicon oxide (SiOCH) film which has Si-CH₂ bond in the carbon containing silicon oxide film, as taught by Jons to incorporate into the Grill's structure to arrive the claimed limitation in order to obtain excellent adhesion to a variety of substrates (col. 5, lines 21-24).

Regarding claims **8 and 10**, Grill discloses the low-k materials (as a SiCOH type dielectric of low dielectric constant ($k < 3.2$) (col. 3, lines 48) that have been considered for

Art Unit: 2818

applications in ULSI devices include polymer containing Si, C, O and H, such as methylsilsesquioxane (col. 1, lines 30-32).

Regarding claim 9, Grill discloses that the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process (col. 3, lines 37-50). However, the limitation "the carbon containing silicon oxide (SiOCH) film is formed by using plasma enhanced CVD process" is taken to be a product by process limitation and consider non-limitation. In a product-by-process claim, it is the patentability of the claimed product and not of the recited process steps which must be established. Therefore, when the prior art discloses a product which reasonably appears to be identical with or only slightly different than the product claimed in a product-by process claim, a rejection based on sections 102 or 103 is fair. The Patent Office is not equipped to manufacture products by a myriad of processes put before it and then obtain prior art product and make physical comparisons therewith. In re Brown, 173 USPQ 685 (CCPA 1972). Also, a product by process claim directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ I S at 17 (footnote 3). See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al., 218 USPQ 289, 292 (Fed. Cir. 1983); and particularly In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product "gleaned" from the process steps, which must be determined in a " product by process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

Art Unit: 2818

Claims 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grill et al. (USP 6,764,774 hereinafter referred to as "Grill") in view of Jons et al. (USP 5,783,452 hereinafter referred to as "Jons") and further in view of Woo et al. (USP 6,555,461 hereinafter referred to as "Woo").

Grill and Jons disclose all the claimed limitations except for a semiconductor device wherein, as a portion of the interlayer insulating film, an SiO₂ film is formed on the upper layer portion of the insulating film; and as a portion of the interlayer insulating film, an insulating film for preventing metal diffusion is formed on the lower layer portion of the insulating film. Woo teaches in Figs. 1a-1i and the corresponding texts as set forth in col. 5, line 60-col. 8, line 54, a metal interconnect structure comprises as a portion of the interlayer insulating film, an SiO₂ film/a cap layer made of silicon oxide 16 (col. 6, lines 25-29) is formed on the upper layer portion of the insulating film 14; and as a portion of the interlayer insulating film, an insulating film/a diffusion barrier 12 (col. 6, lines 4-5) for preventing metal diffusion is formed on the lower layer portion of the insulating film 14. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form an SiO₂ film/a cap layer made of silicon oxide formed on the upper layer portion of the insulating film; and as a portion of the interlayer insulating film, an insulating film/a diffusion barrier formed on the lower layer portion of the insulating film, as taught by Woo in order for protection and preventing metal diffusion.

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grill et al. (USP 6,764,774 hereinafter referred to as "Grill") in view of Jons et al. (USP 5,783,452 hereinafter

Art Unit: 2818

referred to as “Jons”) further in view of Wada et al. (USP 6,071,810 hereinafter referred to as “Wada”).

Grill and Jons disclose all the claimed limitations except for a semiconductor device wherein the Cu containing metal contains, in addition to Cu, at least one of Si, Al, Ag, W, Mg, Be, Zn, Pd, Cd, Au, Hg, Pt, Zr, Ti, Sn, Ni and Fe. Wada teaches in Figs. 22C-22D the Cu 13 containing the Al film 8c is a material which is capable of improving the electromigration resistance as well as the stress migration resistance as set forth in column 70, lines 15-17. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to form the Cu containing metal Al, as taught by Wada in order for improving the electromigration resistance as well as the stress migration resistance.

Allowable Subject Matter

Claims 2 and 7 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, since the prior art made of record and considered pertinent to the applicant's disclosure does not teach or suggest the claimed limitations. The prior art of record, taken alone or in combination, fails to teach or suggest an insulating film wherein the proportion of Si-CH₂ bond (1360cm⁻¹) to Si-CH₃ bond (1270cm⁻¹) in the insulating film is in a range from 0.03 to 0.05 measured as a peak height ratio of FTIR spectrum.

Conclusion

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andy Huynh, (571) 272-1781. The examiner can normally be reached on Monday-Friday from 8:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The Fax number for the organization where this application or proceeding is assigned is (571) 273-8300.

Any inquiry of a general nature or relating to the -status of this application or proceeding should be directed to the receptionist whose phone number is (703) 308-0956.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Ah

Andy Huynh

07/27/05

Patent Examiner